IDAS™ Trunk Solutions

An Overview of Icom's IDAS™ Trunk System Configurations

An Overview prepared by Icom America Inc.

Icom's Digital Advanced System, IDAS™, is a digital Land Mobile Radio (LMR) platform with a scalable architecture. At the core of IDAS is the NXDN™ protocol (Next Generation Digital Narrowband) operating in 6.25 kHz narrowband channels enabling many more potential channels to license than 12.5 kHz solutions. Initially, IDAS products may be deployed as analog or digital, peer-to-peer, simplex configuration. IDAS can then scale to a conventional repeated system, a digital multisite conventional or simulcast LINQ system. IDAS may also be deployed as a single-site trunk or multi-site MultiTrunk™ system.

The Icom IDAS systems all use common hardware and firmware and configuration software. With a few minor accessory additions and configuration options, IDAS devices operate in a configuration that suits your specific needs.

In this document, trunk systems will be discussed. IDAS may be deployed as a single-site trunk system or as a multi-site trunk system, referred to as MultiTrunk. Although there are similarities, such as both are NXDN Type D trunk protocol based, some notable differences in capabilities and uses exist. The following should provide the groundwork to understand where best to employ and key aspects of how the systems operate.

Note: *a key consideration in designing any radio system is creating a coverage map with appropriate overlap between repeaters to ensure that radios communicate properly. In radio communications, there may be coverage issues due to buildings, topography, or atmospheric conditions. Also, a properly functioning IP network with sufficient bandwidth is essential for multi-site systems to operate. To learn more about how to successful deploy a radio system, take a look at our ebook.*

Advantage of Trunking Over Conventional

Before we look into trunking, let's review the advantage of a trunk system over a conventional one. (To learn about Icom's IDAS LINQ conventional systems, see the **IDAS LINQ Overview**.) A trunking system, in general, exists to provide higher channel usage efficiencies than a conventional radio system.
For example, a typical conventional system can only handle one talkpath at a time. This means that if multiple talkgroups have been assigned to a conventional system only one group at a time can utilize the system. All other groups must wait for traffic to clear before they can use the system. To address that, multiple conventional systems can be deployed in series to spread the talkgroups over a number of repeaters.

But in doing so, a talkgroup is limited to the one conventional repeater it is assigned. If all the talkgroups associated to a repeater are inactive for a period, that repeater's temporary idle capacity is unavailable for use by any talkgroups assigned to other repeaters. This occasional wasted idle time is an inefficient use of repeater resources inherent to conventional systems.

With trunking, however, those multiple repeaters are configured to create a single system, managed by a trunking controller, with each repeater handling a talkpath from any talkgroup. When one talkgroup uses a repeater, the other talkgroups have free talkpaths available until all repeaters are busy.

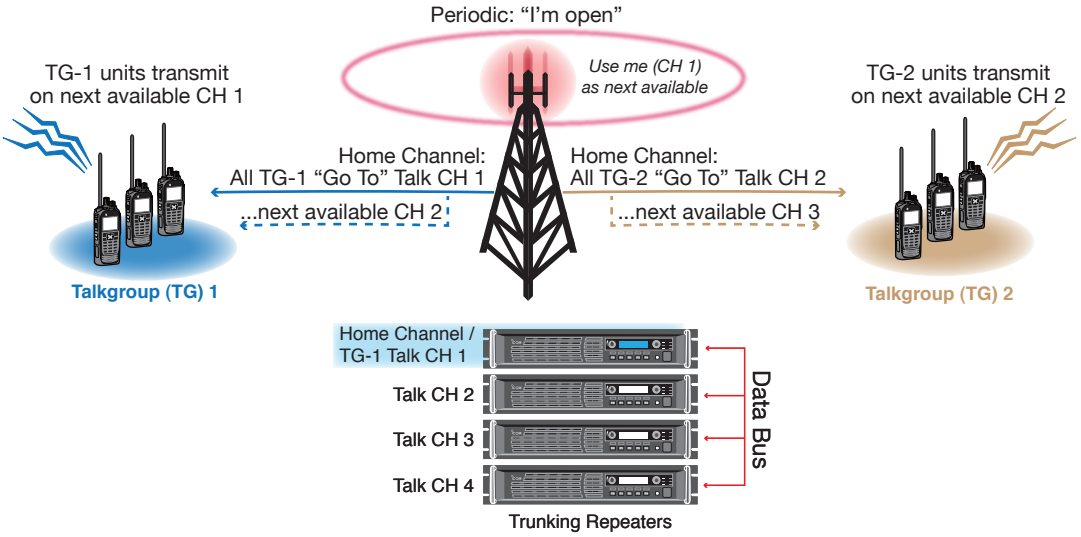
IDAS Trunking Architecture

IDAS solutions are designed around NXDN standards. Within NXDN, IDAS uses the distributed Type-D trunking standard. This is an architecture that uses a home control channel, often referred to simply as a home channel. The IDAS home channel architecture makes every repeater in the system available as a talkpath on every repeater in the system, home channel included.

Other trunking systems have centralized control channel architectures that performs a similar function as the home channel. There are benefits of centralized control channel trunking in that it provides a few more features than a home channel design. But, those features come at a cost:

- Centralized control cannot be used as a voice channel. As an example, it would take five repeater channels on a control channel trunking system to carry the same amount of voice traffic as four repeater channels on a home channel trunking system.
- A control channel must operate on a dedicated FCC license, known as an FB8 license.

A home channel is not required to be on such a hard to obtain FB8 license.



Home Channel Operation

The primary function for a home channel is to direct the subscriber radios to a free repeater. To do so, the home channel and all other repeaters at that site communicate their status over a wired data bus. When a subscriber keys up, it informs the home channel. The home channel then sends an over the air message to all the subscriber radios directing any radios on the requesting radio’s talkgroup to ‘go to’ a specific talk channel. All other subscribers ignore the command and continue monitoring the home channel. Since this is a Transmission Trunking Mode, this process occurs every time a radio is keyed.

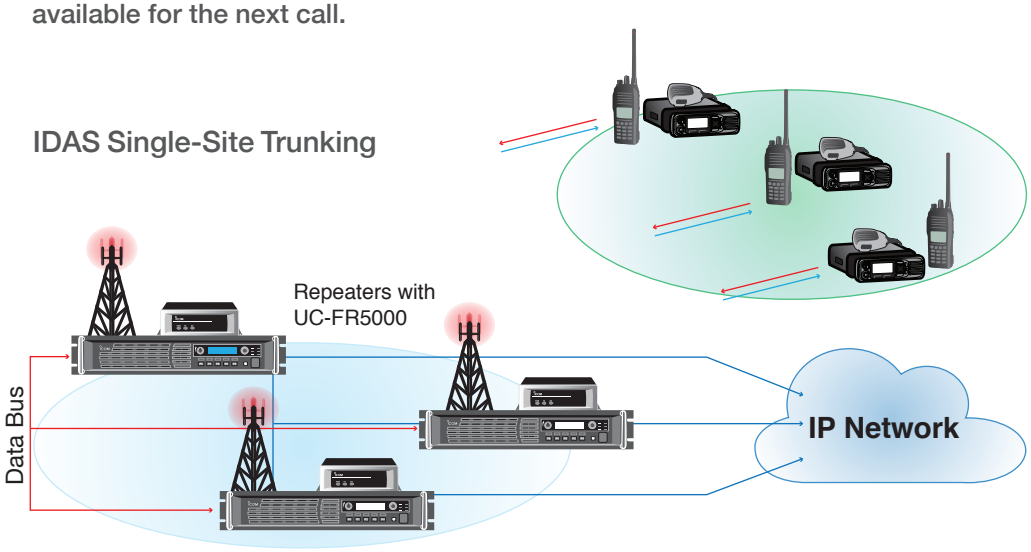
Digital signals result in high voice quality all the way to the edge of coverage.

Often times, that ‘go to’ channel is the home channel itself. When the home channel is busy, included in the over the air voice packet is a command to all radios stating the home channel is busy and to ‘go to’ talk channel X. The next subscriber to key up will transmit to the free talk channel, i.e. repeater 2. Repeater 2 uses the data bus to inform the home channel it has a request for a specific talkgroup. The home channel then sends a message in its voice payload informing all subscribers that this specific talkgroup should to ‘go to’ repeater 2. All other subscribers using different talkgroups ignore the command and continue listening to the home repeater.

This is all made easier because the system is digital. The information, voice or data, is transmitted as 1’s or 0’s and sent as packets over the air. Those packets have a payload structure that is able to contain both voice and data. So, every set of packets sent, voice and control data can be transmitted to the subscriber radio. Another benefit of digital systems is the voice and data sent can use digital methods to improve the signal, such as Forward Error Correction.

Another thing to keep in mind, in a quiet system with no traffic being transmitted, the home channel sends out an 'idle message' every few seconds. The idle message simply tells the subscriber radios that it exists and that it is available for the next call.

IDAS Single-Site Trunking



IDAS Single-Site Trunking

Single-site Trunking is an IDAS trunk system operating in NXDN distributed trunking (Type D) mode that is limited to a single site. An IDAS single-site trunk system can have up to 30 channels. As mentioned, one repeater would be the home channel repeater capable of voice while the other(s) would be voice channel repeaters.

This solution is for a single campus or local geographic region.

Typically, a single-site trunking system is built from the outset to meet site requirements. A single-site system can have up to 30 repeaters. For a single campus, this is a lot of capacity to handle calls. There are cases when this is needed, but a two to ten channel system is more common.

Schools and universities, warehouses, manufacturing plants, hotels and resorts are common applications of a single-site trunking system. These often have a good number of radios in use with multiple groups who only need to talk among themselves and don't want to be distracted by other groups conversations. For example, any campus may have facilities or engineering, custodial, staff, managers, and security groups. Other than in times of emergency, these groups perform better if the only radio talk they hear is from their work group.

With IDAS trunking, an 'all call' capability exists that allows communication to all talkgroups during that infrequent emergency situation. This is enabled using the block decode and priority settings so all subscribers can listen to a talkgroup other than their own which can be set at a higher priority than all other talkgroups.

The full set of features available on the IDAS platform are available in trunking. Features like short data messages (text), status, call alert, radio check, stun / revive / kill, remote monitor, multiple levels of encryption, GPS, lone worker, mandown, superior audio quality (various features dependent on radio model), among others.

At the system level, a second repeater can be configured as a back-up in the event the primary fails. Configuring that secondary home channel is a wise thing to do as it has no penalty in doing so – just a bit extra time in set-up. The subscribers will use the secondary home channel but will continue to look back at the primary. The secondary home channel can be configured with a cover channel feature. A cover channel function tells the subscribers to stop looking back to the primary home channel if it senses the primary has a hard failure.

IDAS Multi-Site MultiTrunk

Multi-site Trunking (MultiTrunk) is an IDAS trunk system operating in NXDN Type D mode with one to 48 sites where multiple sites are connected via an IP network. An IDAS multi-site trunk system can have up to 30 channels per site. MultiTrunk is an extension of single-site trunking. The home channel has the same function and operates in a similar way. Secondary home channels per site can be configured. And, the features found in IDAS apply in MultiTrunk.

This section will focus on the differences between single and multi-site trunking. There are some enhancements, but the bulk of the differences are features that enable multi-site operation.

Roaming from the RF coverage area of one site of trunking repeaters to another poses a healthy set of challenges. IDAS MultiTrunk elegantly addresses those challenges.

Where are the subscriber radios?

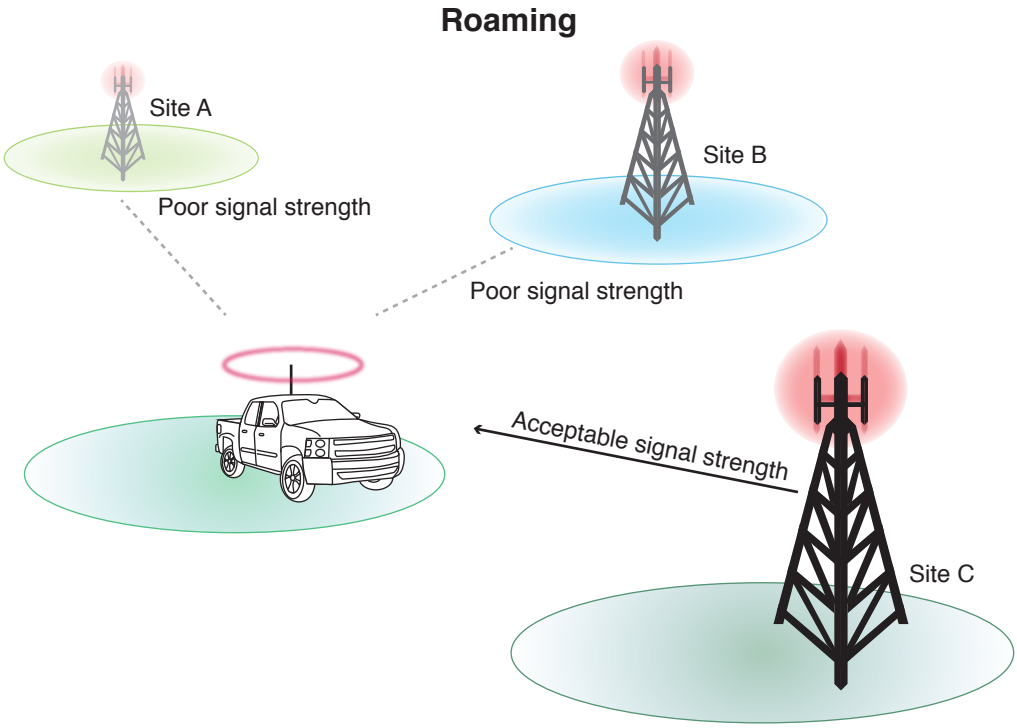
An inelegant approach to that question would be – it doesn't matter. If that approach is taken, and it is a choice you can make, all sites would have a repeater transmit each time any radio keys up. This occurs even if there are no subscribers, or active talkgroups, on that site. While this may be acceptable for a two or three site system where is it likely a radio or talkgroup is at each site, this does not scale. Regional systems with 30 sites may have fleets that operate exclusively in one area. Consuming a repeater on each site for a fleet using only four or five sites is wasteful.

Icom IDAS's solution is to have each subscriber register at the site before accessing the system. MultiTrunk provides ESN (Electronic Serial Number) validation and registration. This can be programmed by a system administrator to use the radio's ESN to validate whether that radio can register on the system. This is a global setting and once enabled, only radio ESN's entered into the system programming will be allowed onto the system. Radios not entered into the system will fail to register.

The registration now gives the system the information to efficiently allocate resources as needed throughout the system. If no one on a specific talkgroup is registered to this site, no repeaters will transmit when that talkgroup keys up, thus freeing resources for use by others. A side benefit of subscriber radio registration is it controls rogue users from using your system further preserving your system capacity.

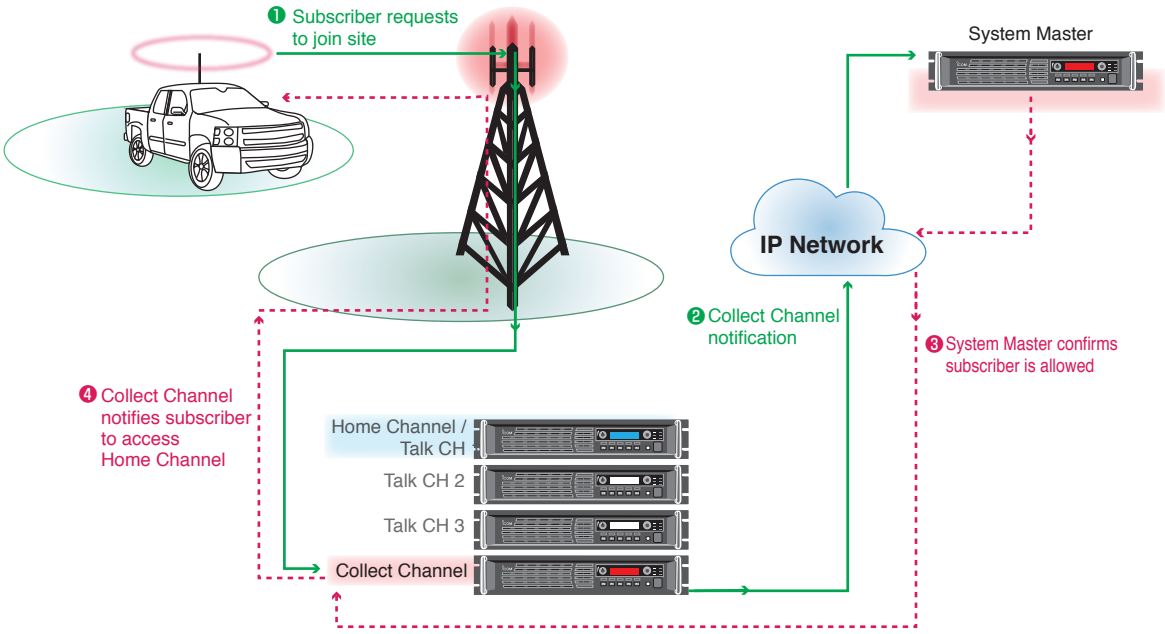
The registration of a particular subscriber is negotiated at each site and communicated to a system master database (which also happens to be an IDAS repeater dedicated to this function). Once the negotiation is complete, all other sites are updated with which site the radio is registered.

What happens when the radio leaves the coverage area of one site and enters the coverage of another?



This is called roaming. There are a lot of things going on in the background to enable roaming. The subscriber radio is continuously monitoring the quality of the signal from the home repeater. As one site's quality diminishes, the radio will shift to a new site if the quality there is better.

Roaming Registration



During that process, the subscriber listens for a 'collect channel' from the new site. The collect channel regularly announces itself. When the radios enter the area, they will find the collect channel and request registration. The collect channel manages the negotiation, which is essentially querying the system master database to see if that radio is allowed on the site/system.

Since the system master database now knows the radio is registered on a site, it communicates that information to all sites. At the end of the registration process the collect repeater tells the subscriber to go to the site home channel so normal trunking activity can begin.

The collect channel is also available as a talk channel.

The collect channel and system master database also push information to the subscriber radios. These aforementioned push updates of any new site collect channels added to the system. This process is called Over the Air Update. This allows the subscribers to have the site collect channels automatically updated without the need for manually reprogramming the subscriber radios as the system adds resources – a convenience for all.

There are several settings to adjust how the radios roam to fine tune the system for the most seamless roaming process. A discussion of those is beyond the scope of this paper, but it is good to know the system has settings to optimize performance.

MultiTrunk has IP-enabled utilities available to the system. Firmware updates, configurations changes, and system health monitoring can be done over IP without needing to travel to the repeater site. A utility for subscriber radio Over-the-Air-Programming is also available. The IP connection to the system enables Icom's remote communicator software to access the system.

MultiTrunk systems may be used by large organizations such as utilities, college campuses, K-12 school districts, municipalities or may be deployed by a radio system operator who rents radios and airtime to clients throughout their RF coverage area.

Conclusion

A trunking system generates higher channel efficiency over conventional systems. IDAS Single-site Trunking can support up to 30 channels in one site. The extended version, IDAS Multi-site Trunking can support 48 sites with 30 channels each. Depending on your needs, there is an option for any operation scale.

As an IDAS solution, there are many useful features to apply so your specific needs are met. Emergency functions, encryption, text messages, status calls, GPS, custom call announcements and much more.

Icom can also connect our LTE or satellite radios to an IDAS trunk system for individuals in the fleet that roam beyond the RF footprint of the trunk system. We can connect Wifi radios or radios of various protocols, like P25, to IDAS trunk systems. Icom is able to create a true team communications environment by connecting disparate technologies to form the right solution to meet your needs.

Experts at Icom America are ready to work with customers to design a system that meets their requirements. This support is critical to ensuring that their system performs as expected. It can be easily upgraded with hardware/software for future use.

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About Icom

Icom started in Japan in 1964, and quickly became a leader in amateur radio products. In the following years Icom has grown to provide radio equipment for marine, land mobile, and avionics applications. It has become a leader in the design and manufacturing of radio equipment that reaches across the spectrum from simple radios to sophisticated IP-based systems. Icom America is responsible for representing Icom products within the entire Western Hemisphere, as well to U.S. Territories in the Pacific. For more information, visit our website or click here to request support.

Glossary

- **All Call.** Radio function that allows communication to all talkgroups during infrequent emergencies.
- **Beaconing.** A signal that is sent by a repeater that enables subscriber radios to receive a transmission for the purposes of subscriber voting.
- **Channel.** A specific frequency (or frequency pair) on which a radio transmits and receives RF signals.
- **Collect Channel.** The channel that authenticates radios to allow it on the system. There is one per site on an IDAS multi-site trunking system.
- **Conventional.** The most basic repeater radio system. A fixed channel, non-trunked, repeater system that receives signals on one frequency and transmits on another.
- **Cover Channel.** Secondary home channel function that informs subscriber radios the primary home channel has a hard failure and that they should stop looking back to it.
- **Downlink.** The signal that a repeater transmits to a subscriber radio.
- **Forward Error Correction.** Forward Error Correction (FEC) is a method used in digital communication where a certain percentage of bits in a string can be corrected by the receiving end based on a code sent along with the data by the transmitting end, thus limiting the need for retransmission of the data.
- **Home Channel.** Channel that directs subscribers to other open channels. The home channel may also be used as a talk channel.
- **Mobile (radio).** A radio designed to be mounted in an automobile.
- **Multicast.** A system of transmitters transmitting the same signal using different downlink frequencies. Note: Downlink frequencies may be reused if transmitters have non-overlapping coverage areas.
- **NXDN™.** A digital protocol that uses 6.25 kHz channel spacing to enable more efficient use of RF frequency spectrum. NXDN was developed jointly by Icom and JVCKenwood.

- **Over-the-Air-Programming.** When a computer application, connected to a radio, sends out programmed files to all select subscribers over an RF channel.
- **Over the Air Update.** A function where a subscriber automatically updates with new frequencies when they register on the collect channel.
- **Portable (radio).** A handheld radio powered with a battery. Power output typically 4-6 watts.
- **Receiver.** Receivers simply accept radio frequency signals.
- **Repeater.** A radio with two different frequencies that simultaneously receives on one and transmits on another to extend the range of an RF signal.
- **RF Hotspot.** A geographical location with a strong radio signal.
- **RSSI.** Receive Signal Strength Indicator. A key metric that radios use to evaluate the strength of a radio signal.
- **Scan.** A radio's ability to look at multiple frequencies and stop at active frequencies.
- **Secondary Channel**. A predefined back-up home channel in an IDAS Trunking system.
- **Simplex.** Radios programmed with the same frequency for both receiving and transmitting.
- **Simulcast.** A multi-site repeater system, using the same frequency set for all sites, where a central controller tells the various transmitters when to transmit so the subscribers receive the transmissions "in-phase".
- **Subscriber.** A radio user radio that is part of a commercial radio system. Also, frequently used as shorthand for either a portable or mobile radio.
- **Subscriber voting.** A form of voting where the subscriber radio evaluates the RSSI signal and transmits on the strongest channel, also called vote scan.

- **System voting.** A form of voting performed by the comparator. Devices in the LINQ system analyze the signals from the subscriber radios and transmits the strongest signal.
- **Talkgroup.** A dedicated group of users on a common channel that is separated from other users using applicable signaling “gates” as found in the IDAS digital protocol.
- **Transceiver.** A radio which has both a receive and transmit capability.
- **Transmission Trunking Mode.** Calls are established only for the duration of the time the Push-to-Talk button is pressed. It is different than Message Trunking where the call remains for the duration of the conversation (similar to a telephone call).
- **Transmitter.** A transmitter is any device that sends a radio-frequency signal.
- **Trunked.** A repeater system that uses a control channel on each site to automatically assign frequency channels to groups of user radios. This controller directs traffic between channels and directs the subscriber units as to which channel to immediately turn to. This gives the system the ability to receive multiple signals at the same time and repeat to other repeater sites.
- **Uplink.** The signal that a subscriber radio transmits to a repeater.

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